

THE CLAIMS

What is claimed is:

1. A downhole tool for generating a mechanical load, the tool comprising:
first and second members each moveable between at least a respective first and a respective further position in response to an applied fluid pressure;
a sealing assembly for preventing fluid flow through the tool, the sealing assembly being released when the first and second members are moved to their respective further positions, so as to allow fluid flow through the tool; and
a generally hollow housing defining an internal bore in which the first and second members are disposed for longitudinal movement therein, the housing defining a flow restriction;
whereby, in use, when the sealing assembly is released the second member impacts a remainder of the tool to generate a mechanical load.
2. A tool as claimed in claim 1, wherein the flow restriction is disposed adjacent an end of the first member.
3. A tool as claimed in claim 1, wherein a part of the bore defining the flow restriction is adapted to slidably receive at least part of the first member.
4. A tool as claimed in claim 1, wherein the flow restriction comprises a nozzle.
5. A tool as claimed in claim 4, wherein the nozzle comprises a separate component adapted to be located in the tool.
6. A tool as claimed in claim 1, wherein the flow restriction is selected to determine a rate of generation of the mechanical tool.
7. A tool as claimed in claim 1, wherein the downhole tool comprises a downhole hammer for generating a mechanical impact load.

8. A tool as claimed in claim 1, wherein the first and second members are movable between first and second positions, respectively, the sealing assembly being adapted to seal between the first and second members during such movement to prevent fluid flow between the first and second members, and wherein the second member is movable to a further position where fluid flow is permitted between the first and second members and through the tool.

9. A tool as claimed in claim 8, wherein the sealing assembly is releasable on further application of fluid pressure, to allow the second member to return to the first position whereby the second member is impacted by a remainder of the hammer.

10. A tool as claimed in claim 1, wherein the first member is adapted to return to the first position before the first member is impacted by the second member.

11. A tool as claimed in claim 1, wherein the sealing assembly comprises respective seal faces of the first and second members.

12. A tool as claimed in claim 1, wherein the first and second members are biased towards their respective first positions.

13. A tool as claimed in claim 1, wherein an end of the first member defines a seal face for sealing abutment with the second member.

14. A tool as claimed in claim 1, wherein at least one flow port is defined in a wall of the first member to selectively allow fluid flow through the first member.

15. A tool as claimed in claim 14, wherein the tool further comprises a housing defining a chamber in fluid communication with the first member through the flow port, for receiving fluid from the first member.

16. A tool as claimed in claim 15, wherein the chamber is in selective fluid communication with the second member, to allow fluid flow between the first member and the second member through the chamber.

17. A tool as claimed in claim 1, further comprising a restraint for restraining movement of the first member relative to the second member to cause the sealing assembly to release, to allow fluid flow between the first and second members.

18. A tool as claimed in claim 17, wherein the restraint comprises a shoulder in the housing adapted to abut and restrain the first member.

19. A tool as claimed in claim 18, wherein the shoulder comprises a substantially radially inwardly extending shoulder adapted to abut a co-operating outwardly extending shoulder on the first member.

20. A tool as claimed in claim 1, wherein the downhole tool comprises a downhole hammer or retrieval tool for generating a mechanical impact load for retrieving an object from a borehole.

21. A tool as claimed in claim 1, wherein when the first and second members are in their further positions, fluid flow allows the second member to return to the first position to impact a remainder of the tool and generate the mechanical load.

22. A tool as claimed in claim 1, wherein the sealing assembly is adapted to seal the tool when the first and second members are in their respective first positions and to allow fluid flow through the tool when the first and second members are in their respective further positions.

23. A tool as claimed in claim 1, wherein the sealing assembly comprises a seal member adapted to prevent fluid flow through the tool when the first and second members are in their respective first positions.

24. A tool as claimed in claim 23, wherein the sealing member is adapted to abut the first member to prevent fluid flow through the tool.

25. A tool as claimed in claim 23, wherein the seal member comprises a valve member adapted to receive and abut the first member to prevent fluid flow through the tool.

26. A tool as claimed in claim 1, wherein the first member includes at least one flow port for fluid flow through the first member when the first member is in the further position.

27. A tool as claimed in claim 1, wherein the first and second members are biased towards their respective first positions.

28. A tool as claimed in claim 1, further comprising a housing defining a chamber in which the second member is mounted, the chamber adapted to receive fluid to move the second member towards the further position.

29. A tool as claimed in claim 1, wherein the downhole tool is activatable in response to a combination of a primary mechanical load applied to the tool and fluid pressure.

30. A tool as claimed in claim 1, further comprising a turning mechanism for rotating at least a part of the tool relative to the remainder of the tool.

31. A tool as claimed in claim 30, wherein the turning mechanism comprises a first mechanism part coupled to the second member of the tool, a second mechanism part for coupling to an object or member to be rotated, and an intermediate mechanism part, coupled to a housing of the tool for rotating one or both of the first and second mechanism parts.

32. A tool as claimed in claim 1, wherein the housing includes at least one port to open part of the housing to external fluid pressure.

33. A tool as claimed in claim 1, wherein the second member includes at least one pressure equalization port for equalizing pressure between the outside and the inside of the second member.

34. A tool as claimed in claim 1, wherein the first member comprises a tubular shuttle valve defining an internal bore.

35. A tool as claimed in claim 34, wherein an end of the shuttle valve defines a seal face for sealing abutment with the second member.

36. A tool as claimed in claim 1, wherein at least one flow port is defined through a wall of the first member to selectively allow fluid flow through the first member.

37. A tool as claimed in claim 1, wherein the second member comprises a tubular piston defining an internal bore.

38. A tool as claimed in claim 1, further comprising a drive transfer coupling for transferring a rotational force through the tool.

39. A tool as claimed in claim 38, wherein the drive transfer coupling includes a key assembly having a channel formed in the coupling and adapted to receive a key to restrain a secondary member coupled to the tool against rotation with respect to the coupling.

40. A tool as claimed in claim 39, wherein the drive transfer coupling includes a plurality of keyways adapted to align with a corresponding plurality of keyways in the secondary member and to receive a respective key in each pair of aligned keyways.

41. A tool as claimed in claim 1, further comprising a key assembly for restraining the second member against rotation with respect to a housing of the tool.

42. A downhole tool for generating a mechanical load, the tool comprising:
a generally hollow housing defining an internal bore and a flow restriction;
first and second members each disposed at least partly in the housing for longitudinal movement with respect to the housing between respective first and second positions in response to an applied fluid pressure;

sealing means for sealing between the first and second members during movement of the members from the respective first to the respective second positions; and

restraint means for restraining movement of the first member relative to the second member so as to cause the sealing means to release, to allow fluid flow between the first and second members;

whereby fluid flow between the first and second members allows the second member to return to the first position, to impact the first member and generate the mechanical load.

43. A downhole tool for generating a mechanical load, the tool comprising:
a generally hollow housing defining an internal bore and a flow restriction;
first and second members each disposed at least partly in the housing for longitudinal movement with respect to the housing between respective first and second positions in response to an applied fluid pressure; and
a sealing assembly adapted to seal the tool to prevent fluid flow through the tool when the first and second members are in their respective first positions and to allow fluid flow through the tool when the first and second members are in their respective second positions;
whereby fluid flow through the tool allows the second member to return to the first position to impact a remainder of the tool and generate the mechanical load.

44. A drilling assembly comprising a drilling motor and a downhole tool as claimed in claim 1.

45. A downhole hammer assembly for hammering a downhole assembly comprising a downhole tool as claimed in claim 1.

46. A rotary drill string assembly including a downhole tool as claimed in claim 1.

47. A downhole fishing assembly for retrieving an object from a borehole, comprising a downhole tool as claimed in claim 1.

48. An assembly as claimed in claim 44, further comprising a shock absorbing tool.

49. An assembly as claimed in claim 48, wherein the shock absorbing tool comprises a body; a shaft moveably mounted to the body; and a biasing assembly coupled between the shaft and the body.

50. A downhole hammer comprising:
a first member; a second member; a generally hollow housing defining an internal bore in which the first and second members are disposed for longitudinal movement therein and a flow restriction; and sealing means between said first and second members, wherein, in use, application of fluid pressure to the hammer causes the first and second members to move from

respective first to respective second positions and during such movement the sealing means sealing between the first and second members substantially prevents fluid flow therebetween; and

wherein further, in use, further application of fluid pressure causes the sealing means to release, to allow the second member to return to the first position whereby the second member is impacted by a remainder of the hammer.

51. A method of drilling a borehole comprising the steps of:
coupling a drill bit to a downhole hammer as claimed in claim 7;
rotating the drill bit;
exerting a first force on the drill bit to cause the drill bit to drill a borehole; and
activating the downhole hammer to exert a second, cyclical hammer force on the drill bit.

52. A method as claimed in claim 51, further comprising activating the hammer by applying a primary mechanical force on the hammer and supplying fluid to the hammer.

53. A method as claimed in claim 52, further comprising urging a shuttle valve and a piston of the hammer from first to second positions under applied fluid pressure whilst sealing between the valve and the piston to prevent fluid flow therebetween.

54. A method as claimed in claim 53, further comprising restraining the shuttle valve against movement beyond the second position, and applying further fluid pressure to move the piston to a further position releasing the seal between the shuttle valve and the piston allowing fluid flow therebetween, to return the piston to the first position to impact a remainder of the hammer and exert the cyclical hammer force on the drill bit.

55. A method as claimed in claim 53, further comprising biasing the shuttle valve towards the first position before the piston returns to the first position.

56. A method as claimed in claim 55, further comprising impacting the piston against the shuttle valve to generating the hammer force.

57. A method of retrieving an object from a borehole comprising the steps of:

coupling a downhole hammer as claimed in claim 7 to the object;
exerting a first force on the downhole hammer and thus on the object; and
activating the downhole hammer to exert an additional, cyclical second force on the object.

58. A method as claimed in claim 57, further comprising activating the impact hammer by applying a primary mechanical pull force on the tool and supplying fluid to the tool.

59. A method as claimed in claim 58, further comprising urging a shuttle valve and a piston of the hammer from first to second positions under applied fluid pressure whilst sealing between the valve and the piston to prevent fluid flow therebetween.

60. A method as claimed in claim 59, further comprising opening fluid flow through the shuttle valve when the shuttle valve is in the second position, to allow fluid flow through the hammer, to return the piston to the first position to impact a remainder of the tool and exert the cyclical retrieval force on the object.

61. A method as claimed in claim 59, further comprising biasing the piston towards the first position before the shuttle valve returns to the first position.

62. A method as claimed in claim 61, further comprising impacting the piston against part of the hammer to generate the retrieval force.

63. A method of expanding an expandable downhole tubular, the method comprising the steps of:

locating an expansion member in unexpanded downhole tubing to be expanded;
coupling a downhole tool for generating a cyclical mechanical load as claimed in claim 1 to the expansion member; and
activating the downhole tool to exert a cyclical mechanical load on the expansion member, to translate the expansion member through the tubing to diametrically expand the tubing.